CONNECTOR WITH INDUCTIVE COUPLING

The present invention relates to a coupling arrangement for transferring electrical energy, in particular an inductive coupling arrangement for connecting a transducer to a measuring device. The invention replaces a conventional electrical connector with an inductive coupler where the electrical signal is alternating.

Conventional electrical connectors rely on conductors being brought into contact with one another and the quality of the contacts can deteriorate because of wear and corrosion of the contact surfaces resulting in noise affecting the transmission signals. Additionally they can result in electrical connections being exposed to the user and, in the case of medical equipment, the patient which could result in harmful circulating currents.

The transducer is normally connected to the electronics by cable connectors, and prior art transducers are usually connected to the electronics by means of a cable having electrical connections. However, electrical connectors for use with such transducers have to withstand numerous sterilisation cycles with approved sterilants and high level disinfectants. These connectors must also be immune to enzyme or detergent solutions and in many cases must be supplied with a protective cover or boot to prevent the ingress of sterilising or disinfectant solutions. Because of the sterilisation process, it is difficult to prevent corrosion or oxidation of the contact surfaces of the connectors even when covered.

In addition they must be capable of withstanding high temperatures and high pressures simultaneously, when autoclaved.

The object of the present invention is to make improvements.

Accordingly, the present invention provides a magnetic coupling for transferring electrical energy to or from at least one transducer and at least one measuring circuit, said coupling comprising a first coil of an inductive coupling arrangement connected to said transducer(s) and a second coil of the inductive coupling arrangement connected to said measuring circuit(s). Preferably, the first and second coils are enclosed in separate housings, the first housing detachably attached within the second housing. Therefore, the electrical energy is transferred without the use of electrical connectors with exposed contact surfaces and avoids the disadvantages of the deterioration of the contacts and the danger to the user.

In a preferred embodiment, the magnetic coupling comprises a cable connector with at least one transducer, the cable connector including a first housing enclosing the end of the cable, a first coil of an induction coupling arrangement electrically connected to the end of the cable within the housing, and a second housing enclosing a second coil of the inductive coupling arrangement, the housings detachably attached to make the signal coupling.

Preferably, the first housing is hermetically sealed to allow for sterilisation. Preferably, the second housing is dimensioned to allow free travel of the first housing to make the signal coupling.

More preferably, the first and second housings are held together by suitable frictional or latching means.

An embodiment of the present invention is described below, by way of example only, with reference to the accompanying drawings in which:

Figure 1 shows a partial sectional view of the male part of the connector;

Figure 2 shows a partial sectional view of the female part of the connector; and

Figure 3 shows the two parts in Figures 1 and 2 joined together.

In inductive connectors, there is no direct transfer of energy from one connector to the other, for example, by means of an electrical connection. Energy is transferred magnetically between connectors in the same manner as in a transformer.

The inductive coupling consists of a male connector part including a coil wound on a magnetic core and a female connector part containing a second coil wound so as to enclose the male connector part.

With reference to Figure 1, a single layer solenoid 7 is wound on a ferromagnetic rod 6 which may be composed of Manganese-Zinc or Nickel-Zinc ferrite material chosen for the desired operating frequency range. The ends of the solenoid winding 5a and 5b are connected to conductors 3a and 3b via solder connections 4a and 4b. Conductors 3a and 3b are connected to an ultrasound probe (not shown) via cable 1. Cable 1 may be of coaxial or twisted pair construction. Solenoid 7, ferromagnetic core 6 and cable terminations 4a, 4b are surrounded by plastic housing 2. A hermetic seal is provided by filling internal void 8 with a synthetic resin (not shown). In addition the synthetic resin provides strain relief for cable 1.

With reference to Figure 2, a plastic housing 10 contains a single layer solenoid 11. Solenoid 11 is dimensioned so as to allow the free travel of the male connector part when the connectors are mated. The ends of solenoid 11 are brought out to terminals 12a and 12b to facilitate electrical connection to the ultrasound drive electronics (not shown). The solenoid 11 may be glued or bonded into the housing 10 by means of synthetic resin or

similar or the housing 10 may be injection moulded around the coil 11.

Figure 3 shows the two connector parts when they are joined together. The connectors may be held together by means of friction or a suitable latching mechanism (not shown).

Although the invention has been described with a specific configuration of the male and female parts, it will be understood that the size of the two parts and their respective coils may be adjusted to optimise the transformer magnetising and leakage inductance for different operating frequencies or different source or load impedances. Futhermore, although the specific example above relates to an ultrasound probe, the invention is equally applicable to similar electrical connections for transducers and their electronics where exposed electrical connections are undesirable. Similarly, although the example relates to a single transducer and its connection, the invention covers multiple transducers and their mutual or individual electrical connections to their electronics.